

Statement of

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Science and Engineering Workforce

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Hearing on

"The NASA Workforce: Does NASA Have the Right Strategy and Policies  
to Retain and Build the Workforce It Will Need?"

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Mr. Chairman, Ranking Minority Member, and committee members: I appreciate the opportunity to testify before you today. My name is David Black. I am the President and CEO of the Universities Space Research Association. The Universities Space Research Association was incorporated in 1969 in the District of Columbia as a private, nonprofit corporation under the auspices of the National Academy of Sciences (NAS). Institutional membership in the Association has grown from 49 colleges and universities when it was founded, to the current 100 institutions. All member institutions have graduate programs in space sciences or technology. Besides the 92 member institutions in the United States, there are two member institutions in Canada, three in Europe, two in Israel, and one in Australia. USRA provides a mechanism through which universities can cooperate effectively with one another, with the government, and with other organizations to further space science and technology, and to promote education in these areas. I am also an Adjunct Professor in the Physics and Astronomy Department at Rice University.

I appear today largely in my capacity as co-chair of the National Research Council (NRC)'s Committee on Issues Affecting the Future of the U.S. Space Science and Engineering Workforce. The NRC is the operating arm of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine of the National Academies, chartered by Congress in 1863 to advise the government on matters of science and technology. The views expressed in my testimony today are in part those expressed by the NRC Committee in its Interim Report,<sup>1</sup> as well as my own. I shall do my best to make clear which views are mine and which are those of the Committee. The latter views are fully supported by my co-chair of the NRC study, Dr. Daniel Hastings, who is Dean for Undergraduate Education and Professor of Aeronautics and Astronautics at MIT.

Prior to addressing the specific issues on which you have asked me to comment, allow me to provide some context for the NRC Committee's activity. I should note that the Committee has completed most of our fact-finding and will be preparing our final report near the end of the calendar year. As such we are not yet prepared to provide a complete set of recommendations but expect to do so in our final report.

The NRC Committee's charge from NASA is to explore long-range science and technology workforce needs to achieve the nation's long-term space exploration vision, identify obstacles to filling those needs, and explore solutions for consideration by government, academia, and industry. The specific tasks that we have been requested to undertake are the following:

1. Assess current and projected demographics of the U.S. aerospace engineering and space science workforce needed to accomplish the exploration vision;
2. Identify factors that impact the demographics of the affected workforces;

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<sup>1</sup> *Issues Affecting the Future of the U.S. Space Science and Engineering Workforce-- Interim Report*, The National Academies Press, Washington, D.C., 2006

3. Assess NASA's list of the workforce skills that will be needed to implement the Vision for Space Exploration, both within the government and in industry;
4. Identify the skills needed to implement NASA's Vision for Space Exploration within the academic community;
5. Assess the current workforce against projected needs;
6. Identify workforce gaps and analyze obstacles to responding to the workforce needs, and in particular, analyze the proper role of academia and the obstacles to achieving this proper role; and
7. Develop recommendations for specific actions by the federal government, industry, and academia to address those needs, including considerations such as organizational changes, recruiting and hiring practices, student programs, and existing workforce training and improvement.

The NRC Committee has drawn upon input from two workshops and documents provided by NASA to arrive at the following preliminary findings:

1. NASA has made a reasonable start on assessing its near-and long-term skill needs, and the Committee shares the view expressed by NASA representatives that there is still much more work to be done. However, NASA's work has focused on initial assessment of current workforce demographics and estimates of future needs, and at the time of the NRC's interim report NASA had not yet translated that analysis into a strategy and action plan.
2. NASA needs a strategic workforce plan that deals with the next five years and that lays the foundation for a longer-term process. This will be a new and difficult process for NASA, but it will nevertheless be vital for the agency's success in implementing the space exploration vision.
3. The Committee has not seen compelling evidence for a looming, broadly based shortage in the supply of aerospace science and engineering workforce employees to meet NASA's needs. (This is not to say, however, that the committee disagrees with the broader issues about the adequacy of the U.S. science and engineering workforce.) However, the committee believes that in order to continue to have an adequate supply of these employees, it is important that NASA provide adequate funding for university based research programs and flight opportunities. This will help ensure that universities continue to sustain curriculum, faculty, and student interest in the aerospace sciences and technologies.
4. To address those skill areas where there are concerns (both for the near term and the longer term), NASA needs to pay particular attention to identifying and expanding ways to promote exchanges of personnel between NASA and the private sector (industry, academia, and non-government organizations).
5. The degree to which the agency chooses to perform work in-house versus by a contractor will play a major role in the number of personnel that the agency will require.
6. The Committee concludes that the ability to recruit and strategically retain the needed workforce will depend fundamentally on the perception of long-term stability of the Vision for Space Exploration and a sustainable national consensus on NASA's mission.

As a result of these findings the NRC Committee made the following recommendations:

1. NASA should develop and publicize a workforce strategy for ensuring that it is able to target, attract, and retain the skilled personnel necessary to implement the space exploration vision and conduct its other missions in the next five to 15 years.
2. NASA should adopt innovative methods of attracting and retaining its required personnel and should obtain the necessary flexibility in hiring and reduction-in-force procedures, as well as transfers and training, to enable it to acquire the people it needs. Transfers within the agency could fill many needs if coupled with appropriate training. NASA should work closely with the DoD to initiate training programs similar to those that the DoD initiated, or otherwise participate actively in the DoD programs.
3. NASA should expand and enhance agency-wide training and mentorship programs, in order to develop or improve needed skills within the existing workforce. For example, NASA could provide some of its employees opportunities for gaining on-the-job experience for its most vital required skill sets such as systems engineering.

As you can see, the NRC Committee has made reasonable progress, but much work remains to address fully the charge that we have been given. That said, let me turn to the questions your committee has posed to me.

**What are the critical skills that will enable NASA to complete its goals in space and earth science, aeronautics, and exploration?**

Although the Committee has not reviewed NASA's critical skill needs on an item-by-item basis, it is likely that the agency will need to maintain at least a small core of employees having skills in the majority of the same areas that the agency has depended upon throughout its history. Individuals with skills and experience in project management and systems engineering will be particularly critical to successful realization of NASA's goals. The NRC Committee intends to examine this issue in more detail in our final report after we have had a chance to evaluate the material that NASA has provided to our Committee. We recognize that this is a daunting task for NASA as it starts with essentially a blank piece of paper. The NRC Committee's initial reaction to NASA's work done so far is that it is incomplete and reflects a top-down view of what skill mixes are needed and as such is more theoretical than empirical.

An essential aspect of any answer to this question is the "make/buy ratio" that NASA decides to implement, i.e. the division of responsibilities for work to be done by the agency's field center employees vs. work to be done by outside contractors. I will comment more specifically on the role of this ratio below, but let me just say here that clearly the demands on NASA's in-house workforce will be lessened if this ratio is low, as some of the requisite skill base can then reside external to the agency.

## **What decisions must NASA make now to prepare for its future workforce needs?**

The NRC Committee has identified several key decisions that NASA faces, and there are sure to be others that will become clear as we complete our study. In the view of our Committee, the most critical decision is the one just discussed, the amount of work done by NASA employees relative to that done in academia and industry. The extent to which NASA decides to develop and operate space systems in-house at its field centers or to contract such work out will have a substantial influence on the skills needed in-house. Moreover, such make/buy decisions also have a strong influence on recruitment of future NASA employees.

Furthermore, NASA needs to determine what means it will use to ensure that prospective employees, entering jobs either inside the government or in the private sector, gain the requisite training and experience in those critical areas that are needed to fulfill the agency's goals and objectives. NASA does have training and mentorship programs, and I should say parenthetically here that my organization has been working with NASA to expand these over the past years, but in general these programs are modest in scope and impact.

NASA also will need to make decisions regarding how it can provide assurance, or perhaps more on point, a sense of "hope and promise" to potential future members of the agency's workforce. Twenty years ago, the mere mention of NASA was an attractor. It had vocational pizzazz. That is no longer the case. Considerable publicity is given to NASA projects that are delayed or cancelled, and there are fewer opportunities for NASA staff to be engaged in meaningful science and engineering. I am concerned that many of the best and brightest young people are attracted to the science part of what NASA does, but the inability of the Administration and Congress to properly fund NASA's implementation of the Vision for Space Exploration will mean that support for science will erode. The research advisors in the academic disciplines associated with these science areas won't have the funding to support the best and brightest graduate students, who may go elsewhere. The ability of NASA to develop ways to reinvent itself in the sense of attracting the best and brightest in its science and engineering competencies is very important.

Finally, NASA will need to decide how much critical mass of expertise should be sustained in key areas such as microgravity life and physical sciences. It is easy to turn off communities with budget decisions, but it is not as easy to turn them on in a timely manner at some point in the future. The employment ecosystem extends from NASA and other similar technical employers through universities and arguably down to high schools. The life scientists needed to do cutting edge research in 2015 are in high school today. How likely are they to choose career paths that would take them to NASA in light of recent decisions to minimize that field of work? A related aspect is that the university community that is the source of NASA's future workforce is already showing signs of steering their best students to other career paths because NASA commitments appear to be uncertain or unstable.

**Does NASA's workforce strategy fulfill the needs identified by the NRC interim report?**

Our Committee has not had a chance to review NASA's new workforce strategy, but will do so as the NRC study moves ahead during this year. The Committee's interim report does suggest a number of important elements that should be included in such a strategy. They include an analysis of future skill needs, both in terms of types of skills and numbers of employees, that is then linked to plans for recruitment and training to meet those needs, as well as plans for partnerships with industry, other government agencies, and academia to meet future training needs.

**What are the tradeoffs associated with completing work in-house at NASA or contracting them out?**

Our Committee has not yet addressed this question thoroughly, so I will have to give you what is largely my personal view at this point. As remarked earlier, the Committee does feel that this tradeoff is one of the more critical, if not the most critical, decision that NASA must make. Whether or not there is strong reliance on external organizations, NASA must retain a cadre of expert engineers and scientists on its own staff. Administrator Griffin has made the point that NASA needs to be a smart buyer, and that requires skilled and knowledgeable employees who are involved with buying decisions and in program management. Recent experience in the DoD indicates that when the government expertise in national security space was allowed to wane, the government made major mistakes in what and how it contracted with industry.

If the decision is to buy rather than build, NASA will not need a large number of people with the requisite skills, but those on whom they rely must be exceptionally skilled and experienced. Choosing a path that emphasizes buying what is needed allows NASA to tap into a skilled workforce that is already largely in place, and which is unencumbered by civil service hiring and firing rules. This latter aspect makes it easier to adjust the workforce as budgets, and program schedules, wax and wane. Selection of the buy path also expands the support base for NASA's programs in a political sense, as employees of companies and universities beyond the NASA field centers have a vested interest in the success of those programs. However, it is important to realize that NASA can never give up the core of talented people necessary to be "smart" buyers. NASA needs to retain enough in-house projects to develop and retain these smart buyers or facilitate exchange with industry to get smart buyers with current experience.

Conversely, should NASA opt to place more emphasis on building what is needed using an in-house workforce, they will need to recognize that in next five years or so, they will have gaps in necessary expertise that cannot be rapidly filled by training current in-house people or by inexperienced new hires. The NRC Committee has examined this issue, and the Committee concludes that ways must be found for NASA to supplement its present workforce with members of industry, the retiree community, and academia who do currently possess the skills required.

The situation for the longer term will depend upon NASA's ability to train in-house staff and to establish an environment that encourages the brightest young students to seek employment with NASA. A key element of this will be to provide opportunities within universities for meaningful hands-on training and experience for students. Data on the trend of NASA-sponsored opportunities of this type show a clear decrease over the past three decades or more (see Figure 1), and a projection into the future given the proposed budgets suggests that this decrease is likely to continue. The knowledge needed to become a skilled project manager is not found in a textbook or classroom; it comes from doing the work and experiencing failures as well as successes. A "build" as contrasted to "buy" approach will allow NASA to offer its employees compelling challenges, which is an important ingredient in making employment with the agency attractive to young people. However the most effective, and perhaps even essential, approach to meeting the needs of both the federal government and industry for people with hands-on experience will be to nurture and expand ways to begin to provide that experience while science and engineering students are still in universities. As a companion NRC study committee recently recommended,<sup>2</sup> that will require reversing the trend of declining opportunities for programs that do provide the hands-on experiences.

In closing my prepared remarks Mr. Chairman, I would note that the NRC Committee feels strongly that NASA needs to look outside of itself in assessing the nature, scope, and possible solutions for its skill mix. NASA has historically been a "can-do" agency, but also one afflicted to some extent with the "not invented here" syndrome. The issues NASA faces in terms of workforce are national in character; they reverberate through other government agencies involved in space-related work, as well as the private sector including universities. NASA should not, in our Committee's view, try to structure a solution in isolation from consultation with the broader set of communities noted above. While we have not formulated a recommendation in this area, I believe I can speak for many people in saying that the nation's space programs would benefit if the issue of workforce is addressed by involving the representatives of the workforce ecosystem in both the assessment of the problem and the range of possible solutions.

I would be happy to expand on my remarks or address additional questions should you wish.

Thank you again for the opportunity to share with your committee the perspectives on this important issue that the NRC Committee has developed in this early stage of our work.

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<sup>2</sup> *Assessment of Balance in NASA's Science Programs*, The National Academies Press, Washington, D.C., 2006.

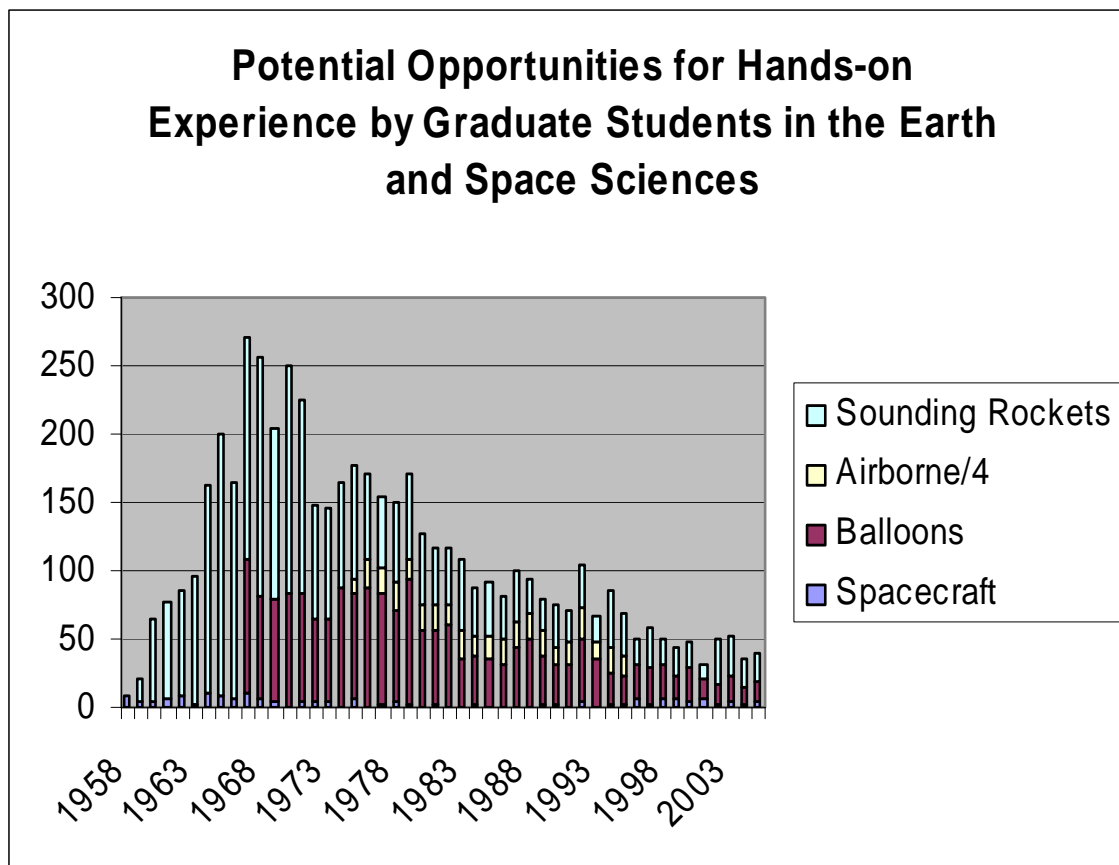


Figure 1. History of opportunities for student hands-on participation in sub-orbital flight experiments and small space missions in Earth and space science.